Chapter 4

1. $T = (1200\ \text{kg})(0 \cdot 60\ \text{m/s}^2) = \underline{720\ \text{N}}$

2. $F = (80\ \text{kg})(1 \cdot 85\ \text{m/s}^2) = \underline{148\ \text{N}}$

3. $m = \dfrac{F}{a} = \dfrac{(255\text{N})}{(4.20\ \text{m}/\text{s}^2)} = \underline{60.7\ \text{kg}}$

4. Problem is subjective. 221 pounds is the force due to gravity on a mass of 221 × 0.454 kg = 100 kg. This weighs 980 Newtons.

5. $F = ma = 14.0\ \text{g}\left[\dfrac{1\ \text{kg}}{1{,}000\ \text{g}}\right](10{,}000 \times 9.8\ \text{m/s}^2) = \underline{1370\ \text{N}}.$

(a) $F = (70\ \text{kg})(9.8\ \text{m/s}^2) = \underline{686\ \text{N}}.$

(b) $F = (70\ \text{kg})(1.7\ \text{m/s}^2) = \underline{119\ \text{N}}.$

(c) $F = (70\ \text{kg})(8.7\ \text{m/s}^2) = \underline{609\ \text{N}}.$

(d) In outer space implies no gravity; constant velocity means no acceleration. Hence $F = 0$; i.e. weight is zero. If there was acceleration, there would be "apparent weight" = ma.

7. Use Eq.(2–10a). $0 = (25\ \text{m/s}) + a(6s)$, $a = -4.17\ \text{m/s}^2$.
$F = (1000\ \text{kg})(-4.17\ \text{m/s}^2) = \underline{-4200\ \text{N}}$; i.e. in direction opposite to velocity.

8. Use Eq. 2–10c
$2ad = v^2$

$$a = \frac{v^2}{2d} = \frac{(500\ \text{m}/\text{s})^2}{2(0.700\text{m})} = 178\ 600\ \text{m/s}^2$$

$$F = ma = (0.00950\ \text{kg})(178\ 600\ \text{m/s}^2) = \underline{1700\ \text{N}}$$

9. The fact that the spider is *descending* does not mean it is *accelerating* down necessarily. This would be to confuse velocity with acceleration. However, in this case, the weight is $(10^{-4}\ \text{kg})(9.8\ \text{m/s}^2) = 9.8 \times 10^{-4}$ N. This is greater than the tension 6.6×10^{-4} N, so

$$a(\text{down}) = \frac{(3.2 \times 10^{-4}\ \text{N})}{(10^{-4}\ \text{kg})} = \underline{3.2\ \text{m/s}^2}.$$

10. Using Eq. 2–10c

$$0 = (40\ \cancel{\text{m/}}6\ \text{m/s})^2 + 2(a)(0.12\text{m})$$
$$a = -6.67 \times 10^3\ \text{m/s}^2.$$
$$F_{\text{Glove on ball}} = m_{\text{ball}}\, a_{\text{ball}}$$
$$F = (0.145\ \text{kg})(6.67 \times 10^3\ \text{m/s}^2)$$
$$= \underline{-967\ \text{N}}\ \text{(opposite to velocity)}$$

By Newton's Third, $F_{\text{ball on glove}} = -F_{\text{glove on ball}} = 967$ N in direction of initial velocity

11. Use Eq. 2–10c

$$a = \frac{(v^2 - v_0^2)}{2x} = \frac{((13\ \text{m/s})^2\ - 0^2)}{2\ (2.8\text{m})}$$
$$= 30.2\ \text{m/s}^2$$
$$F = ma = (7.0\ \text{kg})(30.2\ \text{m/s}^2) = \underline{210\ \text{N}} = \underline{2.1 \times 10^2\ \text{N}}$$

12. Accelerating up: $T - (4750\text{kg})(9.80\ \text{m/s}^2) = (4750\ \text{kg})(0.0500)(9.80\ \text{m/s}^2)$
$T = \underline{6.98 \times 10^4\ \text{N}}$

Accelerating down: $(4750\ \text{kg})(9.80\ \text{m/s}^2) - T = (4750\ \text{kg})(0.0500)(9.80\ \text{m/s}^2)$
$T = \underline{2.33 \times 10^4\ \text{N}}$

13. The child must *accelerate* down in such a way that the tension in the rope is no more than the *weight* it can support, (30 kg);
i.e., $(40\ \text{kg})(9.8\ \text{m/s}^2) - (30\ \text{kg})(9.8\ \text{m/s}^2) = (40\ \text{kg})a$.
Thus, $a = \underline{0.25\ g\ \text{down}}$.

14. $250\ \text{N} - (75\ \text{kg})(9.80\ \text{m/s}^2) = (75\ \text{kg})a$
$a = \underline{-6.47\ \text{m/s}^2}$ (Down)

15. $22\ 500\ \text{N} - (1650\ \text{kg})(9.8\ \text{m/s}^2) = (1650\ \text{kg})a$;
$a = \underline{3.84\ \text{m/s}^2\ \text{up}}$.

16. Use Eq(2–10c). $0 = v_0^2 - 2gh$,
$v_0^2 = 2(9.8\ m/s^2)(0.8\ m)$. $v_0 = 3.96\ m/s$.
What acceleration over 0.2 m was necessary to achieve this as a final velocity?
Use Eq (2–10c). $(3.96)^2 = 0 + 2a(0.2\ m)$. Hence $a = 39.2\ m/s^2$.
For next part, do not forget weight of jumper.
Use $F = ma$. $(P - mg) = ma$;
i.e. $P = M(a + g) = (70\ kg)(39.2\ m/s^2 + 9.8\ m/s^2) = \underline{3430\ N}$.
Actually the force the person exerts against ground is downward (negative). This is the force of the ground on the person.

17. (a) Use Eq (2–10c). $v^2 = 2(9.8\ m/s^2)5\ m$.
$v = \underline{9.9\ m/s\ down}$.

(b) First use Eq (2–10c) to find deceleration.
$0 = (9.90\ m/s)^2 - 2a(0.70\ m)$.
Hence $F - (50\ kg)g = (50\ kg)(70\ m/s^2)$.
$F = \underline{4.0 \times 10^3\ N\ up}$.

18. First 30 m: $v = at$, $30 = \frac{at^2}{2}$; i.e. $v = \left[\frac{60}{t}\right]$.
The next 70 m: $T = 70$. But $t + T = t + \frac{70}{v} = 10\ s$.

These are enough equations to solve the problem. $t = 4.6s$, $a = 2.8\ m/s^2$, $v = 13\ m/s^2$.
Thus (a) $F = (75\ kg)(2.8\ m/s^2) = 210\ N$.

(b) $v = \underline{13\ m/s}$.

19. (a) $F = 70 - 30 = \underline{40\ N}$.

(b) $F = 70 - 60 = \underline{10\ N}$.

(c) $F = \underline{0}$ since box leaves floor.

20. We must cancel the component of the force to the north. This is achieved by a <u>500 N force in a SW direction</u>. Another solution is 500 N in a SE direction but now the force left is zero.

21. (a) $F = F_1 + F_2$

$$F = ((12\ \text{N})^2 + (15\ \text{N})^2)^{\frac{1}{2}} = 19.2\ \text{N}$$

$$\theta = \arctan\left[\frac{15\ \text{N}}{12\ \text{N}}\right] = 51 \text{ from negative x-axis.}$$

$$a = \frac{F}{M} = \frac{19.2\ \text{N}}{10\ \text{kg}} = 1.92\ \text{m/s}^2$$

Force = <u>19 N at 231°</u>
<u>acceleration: 1.9 m/s² at 231°</u>

(b) $F_x = (12\ \text{N})\cos(-30°) + (15\ \text{N})\cos(90°) = 10.4\ \text{N}$
$F_y = (12\ \text{N})\sin(-30°) + (15\ \text{N})\sin(90°) = 9.0\ \text{N}$

$$F = [(10.4\ \text{N})^2 + (9\ \text{N})^2]^{\frac{1}{2}} = 13.8\ \text{N}$$

$$\theta = \arctan\left[\frac{9\ \text{N}}{10.4\ \text{N}}\right] = 40.9°$$

F = <u>14 N at 41°</u>

$$a = \frac{F}{m} = \frac{13.8\ \text{N}}{10\ \text{kg}} = \underline{1.4\ \text{m/s}^2 \text{ at } 41°}$$

22. (a) Retarding force
$f = (90\ \text{N})\cos(45°) = 63.6\ \text{N}$

(b) Normal force
$F_N = (90\ \text{N})\sin(45°) + (16\ \text{kg})(9.80\ \text{m/s}^2)$
$= 201.8\ \text{N}$

(c) $$a = \frac{1.5\ \text{m/s}}{2.5\ \text{s}} = 0.6\ \text{m/s}^2$$

$F\cos(30°) - 77.9\ \text{N} = (16\ \text{kg})(0.6\ \text{m/s}^2)$
$F = 101\ \text{N}$

23. (a) Horizontal Force = $(850\ \text{N})\cos(20°) = 799\ \text{N}$

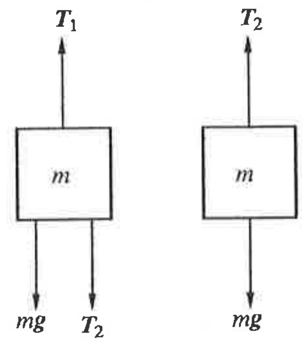
$$a = \frac{F}{m} = \frac{799\ \text{N}}{60\ \text{kg}} = \underline{13\ \text{m/s}^2}$$

(b) Use Eq. 2–10a
$v = (13.3\ \text{m/s}^2)(0.38\text{s}) = \underline{51\ \text{m/s}}$

24. Mass of each bucket is

$$\frac{40.0\ \text{N}}{9.8\ \text{m/s}^2} = 4.08\ \text{kg}$$

For bottom bucket,
$T_2 - 40\ \text{N} = (4.08\ \text{kg})(1.50\ \text{m/s}^2)$
$T_2 = \underline{46.1\ \text{N}}$
For top bucket
$T_1 - T_2 - 40\ \text{N} = (4.08\ \text{kg})(1.50\ \text{m/s}^2)$
$T_1 = \underline{92.2\ \text{N}}$



25. For 12 kg mass
$(12 \times 9.8)\text{N} - T = 12a$
For 10 kg mass
$T - (10 \times 9.8)\text{N} = 10a$
$(2 \times 9.8)\text{N} = 22a \Rightarrow a = \underline{0.89\ \text{m/s}^2}$
$T = 10(g + a) = 10(9.8 + 0.89)\text{N}$
$T = \underline{107\ \text{N}}$.

26. (a) (Total mass) a = Resultant force. $(6500\ \text{kg})(0.55\ \text{m/s}^2) = F - (6500\ \text{kg})(9.8\ \text{m/s}^2)$,
$F = \underline{6.73 \times 10^4\ \text{N}}$.

(b) Consider helicopter: $6.73 \times 10^4 - (5000\ \text{kg})(9.8\ \text{m/s}^2) - T = (5000\ \text{kg})(0.55\ \text{m/s}^2)$.
$T = \underline{1.55 \times 10^4\ \text{N}}$.

27. (a) $2T - mg = 0.\quad F = T = \dfrac{mg}{2} = \dfrac{(75)(9.8)}{2} = \underline{370\ \text{N}}$.

(b) $2.2F - mg = ma.\quad a = \dfrac{2.2\ F}{m} - g = 0.1g = \underline{0.98\ \text{m/s}^2}$.

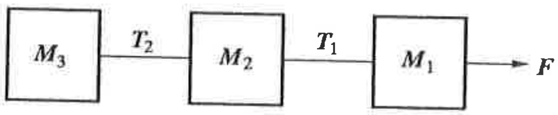
28. $m_1 = m_2 = m_3 = m$

$T_2 = m_3 a$

$T_1 - T_2 = m_2 a$

$F - T_1 = m_1 a$

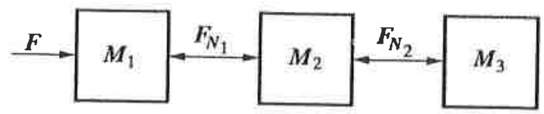
$T_1 = 2T_2$



29. For block m_1, $F - F_{N1} = m_1 a$

For block m_2, $F_{N1} - F_{N2} = m_2 a$

For block m_3, $F_{N2} = m_3 a$



$$a = \frac{F}{m_1 + m_2 + m_3}$$

(b) Net force on block 1, $F_1 = \dfrac{m_1 F}{m_1 + m_2 + m_3}$

Net force on block 2, $F_2 = \dfrac{m_2 F}{m_1 + m_2 + m_3}$

Net force on black 3, $F_3 = \dfrac{m_3 F}{m_1 + m_2 + m_3}$

(c) Blocks 1 and 2 exert $F_{N1} = (m_2 + m_3)\dfrac{F}{m_1 + m_2 + m_3}$ on each other.

Blocks 2 and 3 exert $F_{N2} = \dfrac{m_3 F}{m_1 + m_2 + m_3}$ on each other.

(d) $a = \dfrac{100\ \text{N}}{10\ \text{kg} + 10\ \text{kg} + 10\ \text{kg}} = 3.33\ \text{m/s}^2$

Net force on 1 = (10 kg)(3.33 m/s²) = 33.3 N
Similarly, 2 and 3 have net forces of 33.3 N
F_{N1} = (10 kg + 10 kg)(3.33 m/s²) = 66.7 N.

F_{N2} = (10 kg)(3.33 m/s²) = 33.3 N.

30. When the 3.2 kg mass hits the ground, it has traveled 1.6 m; the 1.2 kg mass is 3.2 m high. Using the results of Exercise 4–9

$a = \dfrac{(3.2\text{ kg} - 1.2\text{ kg})(9.8\text{ m/s}^2)}{(3.2\text{ kg} + 1.2\text{ kg})} = 4.45\text{ m/s}^2$

$v^2 = 2(4.45\text{ m/s}^2)(1.6\text{ m})$.

After reaching a height of 3.2 m, the 1.2 kg mass continues to

$h = 3.2\text{ m} + \dfrac{v^2}{2g} = \underline{3.93\text{ m}}$. This is less than 4 m.

31. $F_p - T_1 = m_1 a$; $T_1 - T_2 = m_c a$; $T_2 = m_2 a$.

Thus $F_p = (m_2 + m_c + m_2)a$, $a = \dfrac{40}{23} = \underline{1.74\text{ m/s}^2}$.

The tension in the cord is not uniform and ranges from T_2 to T_1, i.e. $(12)(1.74) \leq T \leq (13)(1.7)$ or, $21\text{ N} \leq T \leq 23\text{ N}$.

32. $F_s = \mu_s F_N = \mu_s$ kg

$400\text{ N} = \mu_s(40\text{ kg})(9.8\text{ m/s}^2)$

$\mu_s = \underline{1.02}$

33. (a) Need Force = friction for constant speed

$F = \mu_K F_N = \mu_K mg$

$= (0.30)(20\text{ kg})(9.80\text{ m/s}^2)$

$= \underline{59\text{ N}}$

(b) If $\mu_K = 0$, no force is needed

34. $F = \mu R = \mu mg = ma$

Hence $\mu g = a$

$a = (0.8)(9.8\text{ m/s}^2) = \underline{7.84\text{ m/s}^2}$

35. Consider:

Forces perpendicular to plane

$R = mg\cos\theta$

Forces along plane

$F = mg\sin\theta$

At the point of shipping, $\dfrac{F}{R} = \mu = \tan\theta \Rightarrow 0.8 = \tan\theta$

$\theta = \underline{39^\circ}$

36. Frictional force equals $m(5.8)$. For motion uphill assume same frictional force. $m(5.8) + m(9.8)\sin 12^\circ = ma$. Hence $a = \underline{7.84\text{ m/s}^2}$, down the slope.

37. $\mu m_1 g \geq m_2 g$

$m_1 \geq \dfrac{m_2}{\mu} = \dfrac{2\text{ kg}}{.2} = \underline{10\text{ kg}}$

38. $ma = F = -mg(0.3)$. Hence $a = -2.94$ m/s^2.
Use Eq (2–10c). $0 = (3.0 \text{ m/s})^2 + 2(-2.94 \text{ m/s}^2)d$.
$d = \underline{1.53 \text{ m}}$.

39. $650 - 0.2(80 + 110)(9.8) = (80 + 110)a$.

(a) Thus $a = \underline{1.5 \text{ m/s}^2}$

(b) Consider 110–kg–crate: $F = ma + \mu mg = (110)(1.5 + 0.2 \times 9.8) = \underline{380 \text{ N}}$.

40. (a) $a_{max} = \mu g$. $v^2 = 2a_{max}\, d_{min}$ from Eq (2–10c)

Thus $d_{min} = \dfrac{v^2}{2\mu g}$.

(b) $(25)^2/2/0.85/9.8 = \underline{37.5 \text{ m}}$.

(c) $g_{moon} = \dfrac{g}{6}$,

$d_{moon} = 6d = \underline{225 \text{ m}}$.

41. $F = \mu mg = ma$. $a = 0.65(9.8) = \underline{6.4 \text{ m/s}^2}$

42. Acceleration is $(9.8 \text{ m/s}^2)(\sin 6.8^\circ)$. Use Eq (2–10b).

$2 = (9.8 \text{ m/s}^2)(\sin 6.8^\circ)\dfrac{t^2}{2}$. $t = \underline{1.86 \text{ s}}$.

43. (a) $mg \sin\theta = ma$. $a = g \sin\theta = 9.8 \sin 20^\circ = \underline{3.4 \text{ m/s}^2}$

(b) From Eq (2–10c), $v^2 = 2ad$; $v = [(2)(3.35)(12)]^{\frac{1}{2}} = \underline{9.0 \text{ m/s}}$

44. (a) From Eq (2–10c), $-v_0^2 = 2ad$; $d = -5^2/2/(-3.35) = \underline{3.73 \text{ m}}$.

(b) From Eq (2–10b), $0 = (-5)t + (0.5)(3.35)t^2$; $t = \underline{2.99 s}$.

45. (a) $mg \sin\theta - \mu mg \cos\theta = ma$. $a = g(\sin\theta - \mu \cos\theta) = 9.8(\sin 20^\circ - 0.2 \cos 20^\circ) = \underline{1.5 \text{ m/s}^2}$

$v = [2(1.51)(1.2)]^{\frac{1}{2}} = \underline{1.9 \text{ m/s}}$.

(b) $a = g(\sin\theta + \mu\cos\theta) = 9.8(\sin 20^\circ + 0.2 \cos 20^\circ) = 5.19$ m/s^2
$d = -5^2/2/(-5.19) = \underline{2.4 \text{ m}}$.
$0 = (-5) + 5.19t_{up}$; $t_{up} = 0.96$ s.
$2.41 = (0.5)(1.51)\, t^2_{down}$; $t_{down} = 1.79$ s.
$t = t_{up} + t_{down} = \underline{2.7 \text{ s}}$.

46. Acceleration due to gravity is a vector. Its component down the slope is g sin 45°. Use Eq (2–10c).
$v^2 = (1.67 \text{ m/s})^2 + 2(9.8 \text{ m/s}^2)(\sin 45°)(60 \text{ m})$, (6 km/h = 1.67 m/s)
v = 28.9 m/s.

47. Normal force is $mg \cos \theta$ because there is no acceleration perpendicular to the slope.

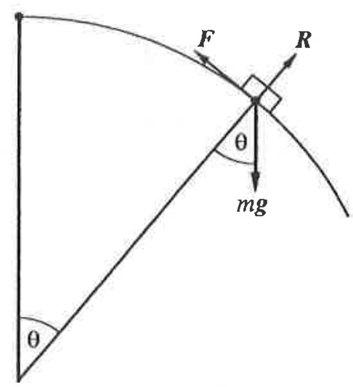
Down the slope: $mg \sin \theta - \mu mg \cos \theta = ma$; and $\mu = \dfrac{g \sin \theta - a}{g \cos \theta} = 0.613$.

Friction Force is $\mu mg \cos \theta$ = 90.7 N.

48. At the point of slipping
$F_N = mg \cos \theta$
$F = mg \sin \theta$

$\dfrac{F}{R} = \tan \theta$

But $\dfrac{F}{R} = \mu = \tan \theta$
$\theta = \tan^{-1} 0.6 \Rightarrow \theta = 31°$



49. (a) $m_1 g \sin \theta - T = m_1 a$; $T - m_2 g = m_2 a$.

$$a = \frac{(m_1 \sin \theta - m_2)g}{(m_1 + m_2)}.$$

(b) $m_1 \sin \theta > m_2$ implies m_1 down the plane.

$m_1 \sin \theta < m_2$ implies opposite direction.

50. $T - m_1 g(\sin \theta + \mu \cos \theta) = m_1 a$; $m_2 g - T = m_2 a$.

$$a = \frac{[m_2 - (\sin \theta + \mu \cos \theta)m_1]g}{m_1 + m_2} = 1.81 \text{ m/s}^2.$$

51. $1 - (\sin 30° + \mu \cos 30°) = 0$; μ = 0.58.

52. W, wind force uphill, is (70)(9.8)(sin 7°) for no acceleration. When going uphill, W is down slope.
Thus $F = W + (70)(9.8)(\sin 7°) = 2W$ = 167 N.

53. $F = ma = m\dfrac{\Delta v}{\Delta t} = \dfrac{(0.02)(0.35 - 0.25)}{(0.1)} = 0.020 \text{ N}.$

54. 90 km/h = 25 m/s
$F = ma = (70\ \text{kg})(30 \times 9.8\ \text{m/s}^2)$
$F = 2.05 \times 10^4$ N.
Using 2.10 *c*
$0 = (25\ \text{m/s})^2 - (2)(30 \times 9.8\ \text{m/s}^2)x$
$x = \underline{1.1\ \text{m}}$

55. $f_s = \mu_s mg = ma$

$$\mu_s = \frac{a}{g} = \frac{0.20g}{g} = 0.20$$

56. Any external friction force on car is included in 3.2×10^3 N.
$(3.5 \times 10^3) - (0.15)(450)(9.8) = 1450a$. $a = 1.96\ \text{m/s}^2$.
$T - (0.15)(450)(9.8) = (450)(1.96)$
$T = \underline{1.54 \times 10^3\ \text{N}}$.

57. Using $F = ma = \mu mg$
$a = -\mu g = 0.8g$ N
Assuming the final velocity is zero and using Eq. (2.10c)
$0 \approx v_0^2 - 2(0.8 \times 9.8\ \text{m/s}^2)(80\ \text{m})$
$v_0 \approx \underline{35\ \text{m/s}} \approx 130$ km/h

58. The hill has slope θ, such that $\sin\theta = 0.25$. Resolve acceleration due to gravity down the hil
$a = (9.8\ \text{m/s}^2)(0.25)$. Use Eq (2–10c). $v^2 = 2(2.45\ \text{m/s}^2)(50\ \text{m})$; $v = \underline{15.7\ \text{m/s}}$.

59. Normal force to plane is $mg\cos\theta$. Friction up slope is $\mu mg\cos\theta$.
For motion down slope: $(mg\sin\theta - \mu mg\cos\theta) = ma$;
i.e. $a = (9.8\ \text{m/s}^2)(0.25) - 0.10(9.8\ \text{m/s}^2)(0.97) = 1.50\ \text{m/s}^2$.
Now use Eq (2–10c). $v^2 = 2(1.50\ \text{m/s}^2)50\ \text{m}$, $v = \underline{12\ \text{m/s}}$.

60. (a) $f_K = \mu_K mg\cos\theta$
$-f_K - mg\sin\theta = ma$
$a = -g(\mu_K\cos\theta + \sin\theta)$
Use Eq. 2–10c:
$2ad = (0)^2 - v_0^2$

$$a = \frac{-v_0^2}{2d}$$

$$-g(\mu_K\cos\theta + \sin\theta) = \frac{-v_0^2}{2d}$$

$$\mu_K = \underline{\frac{v_0^2}{2dg\cos\theta} - \tan\theta}$$

60. (b) At rest at top.

$f_s \le \mu_s mg \cos \theta$

$f_s = mg \sin \theta$

$$\mu_s \ge \frac{\sin \theta}{\cos \theta}$$

$\mu_s \ge \underline{\tan \theta}$

61. $F = \mu mg = ma$. $a = -\mu g = -0.8(9.8) = -7.84$ m/s^2.
Use Eq. (2–10c). $v^2 = 20^2 + 2(-7.84)(15) > 0$.
Therefore, <u>yes</u>. $v = \underline{12.8 \text{ m/s}}$

62. Given: $v_o = 0$, $v = 14$ m/s, $t = 8.0$ s, $m = 1000$ kg

$$\max a = \frac{v - v_o}{t} = \frac{14 \text{ m/s}}{8 \text{ s}} = 1.75 \text{ m/s}^2,$$

$\max F = ma = (1000 \text{ kg})(1.75 \text{ m/s}^2) = \underline{1750 \text{ N}}$.

$\Sigma F_y = F_N - mg\cos \theta = 0$

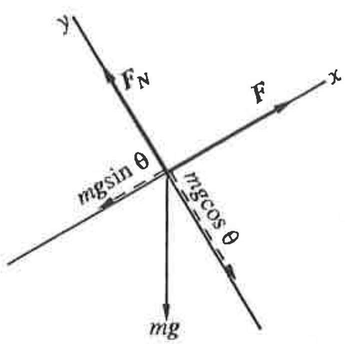
$F_N = mg\cos \theta$

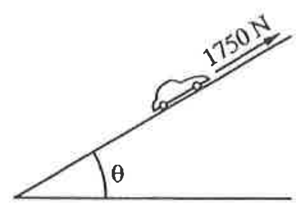
$\Sigma F_x = F - mg\sin \theta = 0$

$F = mg\sin \theta$

$$\sin \theta = \frac{F}{mg}$$

$$\theta = \sin^{-1}\frac{F}{mg} = \sin^{-1}\left[\frac{1750 \text{ N}}{9800 \text{ N}}\right] = \underline{10.3^\circ}$$





63. (a) Weight resolved downhill is $mg \sin \theta = (80 \text{ kg})(9.8 \text{ m/s}^2)(\sin 4^\circ) = c(6 \text{ km/h})$ for no acceleration. Hence $c = \underline{9.1 \text{ N h/km}}$.

(b) The extra force to achieve 20 km/h is (20 km/h – 6 km/h)9.1 = <u>127 N</u>.

Chapter 5

1. 1800 km/h = 500 m/s
v^2/r = (500 m/s)^2/(4000 m) = 62.5 m/s^2 = 6.38 g

2. (a) v^2/r = (1.25 m/s)^2/(11.0 m) = 0.142 m/s^2

   (b) (25.0 kg)(0.142 m/s^2) = 3.55 N

3. $a = (2\pi r/T)^2/r$ = (1.5 × 10^{11} m)(2π/3.15 × 10^7 s)^2 = 5.97 × 10^{-3} m/s^2.
$F = ma$ = (5.98 × 10^{24} kg)(5.97 × 10^{-3} m/s^2) = 3.57 × 10^{22} N.

4. 26.0 N = (0.80 kg)v^2/(0.50 m)
v = 4.03 m/s

5. $\mu mg = mv^2/r$
(0.60)(1000 kg)(9.80 m/s^2) = (1000 kg) v^2/(85 m)
v = 22 m/s
Yes, independent at mass.

6. 55 km/h = 15.3 m/s
$\mu mg = mv^2/r$
μ = (15.3 m/s)^2/(68 m)/(9.80 m/s^2)
μ = 0.351

7. 42 rpm
v = 42(2π)(0.13 m)/(60 s) = 0.578 m/s
$\mu mg = mv^2/r$
μ = (9.80 m/s^2) = (0.578 m/s)^2/(0.13 m)
μ = 0.26

8. All force for centripetal acceleration is being provided by gravity as pressure on seat is just zero.
$mg = mv^2/r$. v^2 = (8 m)(9.8 m/s^2). v = 8.85 m/s.

9. $L/T^2 = a = v^c r^d = (L/T)^c L^d = L^{c+d}/T^c$. Hence $c = 2$, $d = -1$.